

# 经后路椎板内固定术治疗颅颈交界区畸形合并寰枢椎脱位

薛兴森 叶信珍 黄毅 陈景宇 储卫华 邹明明 陈飞 林江凯

**【摘要】 目的** 观察经后路椎板内固定术治疗颅颈交界区畸形合并寰枢椎脱位的临床疗效。**方法** 对 2010 年 4 月-2011 年 11 月诊断明确的颅颈交界区畸形合并寰枢椎脱位的 12 例患者进行经后路减压复位螺钉-钛棒(板)系统内固定术。应用 CT 薄层扫描及三维 CT 重建术测量手术前后寰齿间距(ADI)、硬腭枕骨大孔线(CL)和斜坡枕骨大孔线(ML)上方距离,通过延髓脊髓角(CMA)评价脊髓受压程度,以日本骨科协会(JOA)17 分评分系统评价颈脊髓神经功能改善程度;神经电生理学方法监测神经传导功能,同时分析经后路减压复位螺钉-钛棒(板)系统内固定术治疗颅颈交界区畸形合并寰枢椎脱位的可行性。**结果** 共随访 4~20 个月(平均 13 个月)。与手术前 ADI $[(4.42 \pm 2.91) \text{ mm}]$ 、CL $[(10.31 \pm 3.80) \text{ mm}]$ 、ML $[(3.24 \pm 2.92) \text{ mm}]$ 、CMA $[(127.83 \pm 8.75)^\circ]$ 及 JOA 评分 $(9.75 \pm 2.59)$ 相比,手术后 ADI $[(2.96 \pm 2.08) \text{ mm}]$ 、CL $[(7.16 \pm 3.19) \text{ mm}]$ 、ML $[(0.29 \pm 2.36) \text{ mm}]$ 减小,CMA $[(134.10 \pm 8.38)^\circ]$ 及 JOA 评分 $(14.83 \pm 2.94)$ 增加,治疗前后比较差异具有统计学意义( $P < 0.05$  或  $P < 0.01$ )。其中,手术前神经电生理学监测波形异常的 10 例患者中 7 例术后完全恢复正常形态。术后 MRI 检查显示,颅颈交界区减压充分,无一例出现内固定松动或断裂;随访期间植骨获得骨性融合,未出现并发症。**结论** 经后路椎板内固定术治疗颅颈交界区畸形合并寰枢椎脱位临床疗效满意,手术安全、可行。

**【关键词】** 脱位; 寰枢关节; 脊柱融合术; 颈椎; 骨螺丝

DOI: 10.3969/j.issn.1672-6731.2012.04.014

## Clinical analysis of posterior lamina internal fixation for the treatment of atlantoaxial dislocation with craniovertebral junction region malformation

XUE Xing-sen, YE Xin-zhen, HUANG Yi, CHEN Jing-yu, CHU Wei-hua, ZOU Ming-ming, CHEN Fei, LIN Jiang-kai

Department of Neurosurgery, Southwest Hospital, Third Military Medical University, Chongqing 400038, China

Corresponding author: LIN Jiang-kai (Email: jkclin2002@yahoo.com.cn)

**【Abstract】 Objective** To study the efficacy of posterior lamina internal fixation for the treatment of atlantoaxial dislocation with craniovertebral junction region malformation. **Methods** In April 2010 to November 2011, 12 patients suffered from atlantoaxial dislocation complicated with craniovertebral junction region malformation were treated at our department. All patients underwent decompressed reduction and screw-titanium rod (plate) system internal fixation. CT thin layer scanning and 3D CT reconstruction were performed. Pre- and post-operative atlanto-dental interval (ADI), Chamberlain's line (CL) distance and McRae's line (ML) distance were measured. The degree of spinal cord compression was evaluated by cervicomedullary angle (CMA). Japanese Orthopaedic Association (JOA) score was used to assess the improvement of cervical medullary function. Electroneurophysiology was applied to detect nerve conduction function. Clinical effect of this surgical procedure was analysed. **Results** All patients were followed up for 4-20 months (mean 13 months). The differences of preoperative and postoperative ADI  $[(4.42 \pm 2.91) \text{ mm vs } (2.96 \pm 2.08) \text{ mm}]$ , CL  $[(10.31 \pm 3.80) \text{ mm vs } (7.16 \pm 3.19) \text{ mm}]$ , ML  $[(3.24 \pm 2.92) \text{ mm vs } (0.29 \pm 2.36) \text{ mm}]$ , CMA  $[(127.83 \pm 8.75)^\circ \text{ vs } (134.10 \pm 8.38)^\circ]$  and JOA  $[(9.75 \pm 2.59) \text{ scores vs } (14.83 \pm 2.94) \text{ scores}]$  were all statistically significant. In electroneurophysiological examination, preoperative waveform was abnormal in 10 cases, while 7 cases recovered to normal. Imaging examination showed bony fusion at

基金项目:第三军医大学校级课题(项目编号:2010XLC013)

作者单位:400038 重庆,第三军医大学西南医院神经外科

通讯作者:林江凯(Email:jkclin2002@yahoo.com.cn)

bone grafting area, and no abnormal appearances after internal fixation. In follow-up period no complication occurred. **Conclusion** Posterior lamina internal fixation for the treatment of craniovertebral junction region malformation with atlantoaxial dislocation is safe, feasible and effective.

**【Key words】** Dislocations; Atlanto-axial joint; Spinal fusion; Cervical vertebrae; Bone screws

**Fund Project:** Research Projects of Third Military Medical University (No. 2010XLC013)

寰枢椎脱位(AAD)为颈椎上部常见病变,按病因可分为外伤性寰枢椎脱位和自发性寰枢椎脱位。其中,自发性寰枢椎脱位多伴有颅底先天性畸形,如 Chiari 畸形(CM)、扁平颅底(platybasia)等,其手术治疗仍是神经外科临床的重点及难点。第三军医大学西南医院神经外科自 2010 年 4 月-2011 年 11 月共治疗颅颈交界区(CVJ)畸形合并寰枢椎脱位患者 12 例,均采用经后路术中撑开复位及枢椎椎板螺钉内固定术,取得较为理想的临床效果。

## 资料与方法

### 一、一般资料

本组 12 例患者,男性 5 例,女性 7 例;发病年龄 13~60 岁,平均 40 岁,发病高峰年龄为 30~49 岁,共 7 例。病程 1 d 至 20 年,均为先天性发育畸形,无类风湿性关节炎及创伤史。临床主要表现为进行性肢体麻木、乏力,逐渐出现脊髓压迫症状,其中四肢麻木、乏力 10 例,枕颈部疼痛 9 例,行走不稳 8 例,肌萎缩 6 例,大小便异常 6 例,吞咽困难 4 例,构音障碍 3 例。

### 二、辅助检查

1. 影像学表现 患者入院后分别行颈椎过伸、过屈位 X 线检查,颅颈交界区 CT 血管造影(CTA),CT 薄层(<2.00 mm)扫描,MRI 平扫、增强扫描及三维重建。所有患者均可见颅底凹陷并伴有寰枕融合(12 例,图 1)、Chiari 畸形(10 例)、C<sub>2,3</sub>融合(5 例)、脊髓空洞(5 例)、脑积水及脊柱侧弯(各 1 例)。MRI 检查显示,齿状突明显向后上移位,脊髓受压,脑脊液循环不畅等征象(图 2)。

2. 神经电生理学检查 体感诱发电位(SEP)检测显示,双侧上肢 N20、P25 和 N30 波潜伏期明显延长(5 例),波幅降低(5 例),波形分化不良(7 例);双侧下肢 P40、N50 和 P60 波潜伏期延长(5 例),波幅降低(9 例),波形分化不良(7 例)。

### 三、手术方法

1. 操作步骤 所有患者均行气管插管全身麻

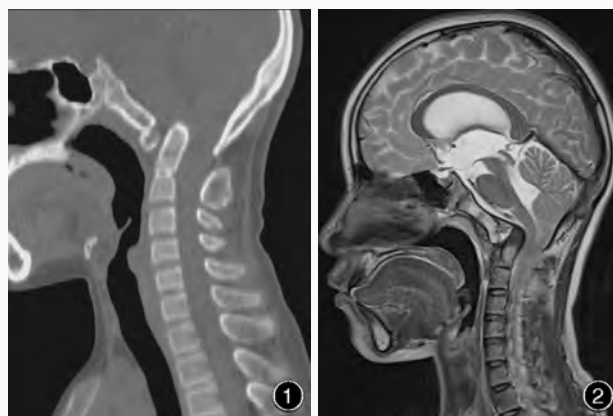


图 1 术前矢状位 CT 检查显示颅底凹陷伴寰枕融合 图 2 术前矢状位 MRI 检查显示脊髓严重受压

**Figure 1** The sagittal CT shows basilar invagination with atlanto-occipital fusion **Figure 2** The sagittal MRI shows severe spinal cord compression

醉,俯卧位,头颈正中位并头架固定,无需术中牵引。采取枕颈后正中切口,充分显露枕骨鳞部、枢椎棘突、椎弓,以及寰椎后弓及枕骨大孔后缘。行枕骨大孔后缘减压,骨窗大小约为 25 mm×20 mm,松开头架,谨慎固定旋钮,使头处于中立位;咬骨钳咬除枢椎(C<sub>2</sub>)部分棘突,根据术前预测的枢椎椎板长度、厚度并选择左、右侧椎板螺钉长度分别为(28.89±2.37) mm、(29.04±3.19) mm;椎板厚度(4.56±0.60) mm、(4.76±0.87) mm;椎板长轴与矢状面夹角(45.43±6.38)°、(48.06±5.94)°。经后路椎板螺钉内固定钛钉、钛棒系统<sup>[1]</sup>自枢椎棘突两侧各朝向对侧椎板钻孔,并植入椎板间螺钉(美国强生公司生产的 SUMMIT/TI 微型多向螺钉,左侧椎板内螺钉长度为 22~26 mm、右侧椎板内螺钉为 20~24 mm),于枕骨植入钛片(美国强生公司生产的 SUMMIT/TI 倒“Y”形枕骨板)和螺钉[(美国强生公司生产的 SUMMIT/TI 微型平头钉,上螺钉长度(9±1) mm、下螺钉长度(8±1) mm)]进行固定,塑形钛棒(美国强生公司生产的 SUMMIT/TI 型钛棒)连接钛片与双侧枢椎椎板螺钉,撑开器缓慢撑开枢椎椎体与枕骨,使齿状突尽量向下、向前移位,直至不能撑开即表明齿状突复位完全。然后取单侧髂后上棘

碎骨植入枕骨骨窗及植入物周围,反复以适量生理盐水冲洗、逐层缝合,无需留置引流管。术中撑开复位及螺钉固定前后均行神经电生理学监测,提示肢体异常波形明显改善,术后第 3 天于颈托保护下进行早期康复训练。

2. 临床功能评价 患者分别于术前第 3 天、术后出院前及最终随访时(平均 13 个月),采用 CT 薄层扫描和三维 CT 重建术测量寰齿间距(ADI)、硬腭枕大孔线(CL)及斜坡枕大孔线(ML)上方距离,观察齿状突复位程度;通过延髓脊髓角(CMA)评价脊髓压迫程度;日本骨科协会(JOA)17 分评分系统评价脊髓型颈椎病患者的神经功能。

#### 四、统计分析方法

采用 SPSS 18.0 统计软件进行数据分析。计量资料以均数  $\pm$  标准差( $\bar{x} \pm s$ )表示,手术前后 ADI、CL、ML、CMA 及 JOA 评分等数据的比较行配对  $t$  检验。以  $P \leq 0.05$  为差异具有统计学意义。

### 结 果

所有患者均于手术后第 10 天拆线,出院时临床症状好转,四肢麻木、头颈部疼痛、肌力及肌张力、

括约肌障碍等表现明显缓解甚至完全消失;第 8~12 周时 CT 或 MRI 检查显示,植骨区骨性融合后外固定牢固(图 3),螺钉在椎板内的轨迹良好(图 4),脊髓受压程度明显缓解,固定满意、无移位(图 5)。与手术前 ADI、CL、ML、CMA 及 JOA 评分等项测量数据相比,术后第 7 天及随访(4~20 个月,平均 13 个月)时临床症状均明显改善,且手术前后差异具有统计学意义( $P < 0.05$ ,表 1)。术后体感诱发电位检查可见潜伏期缩短,波幅增大。随访过程中,植骨区均获得充分骨性融合。

### 讨 论

颅底畸形可伴有寰枢椎脱位,由于寰枢关节负荷和旋转的不稳定<sup>[2]</sup>,造成局部骨质和韧带破坏,易引起局部神经根疼痛、脊髓甚至延髓压迫<sup>[3]</sup>。临床主要表现为枕颈部疼痛、旋转受限及脊髓受压症状,可合并高位颈神经根受累,早期易被误诊为颈椎椎间盘突出症;若伴有先天性  $C_{2,3}$  融合,更易造成寰枢关节脱位<sup>[4]</sup>。由于齿状突处于中枢部位,脱位可引起严重的神经功能障碍,需行手术治疗<sup>[5]</sup>,以解除颅颈交界区对脊髓甚至延髓的压迫,恢复或稳定

表 1 经后路椎板内固定术手术前后各项数据的比较( $\bar{x} \pm s$ )

Table 1. Comparison of pre- and post-operation data of posterior lamina internal fixation treatment ( $\bar{x} \pm s$ )

组别	例数	ADI(mm)	CL(mm)	ML(mm)	CMA( $^{\circ}$ )	JOA 评分
手术前	12	4.42 $\pm$ 2.91	10.31 $\pm$ 3.80	3.24 $\pm$ 2.92	127.83 $\pm$ 8.75	9.75 $\pm$ 2.59
手术后	12	2.96 $\pm$ 2.08	7.16 $\pm$ 3.19	0.29 $\pm$ 2.36	134.10 $\pm$ 8.38	14.83 $\pm$ 2.94
$t$ 值		4.386	5.654	4.088	7.919	9.362
$P$ 值		0.001	0.000	0.002	0.000	0.000

注:ADI,寰齿间距;CL,硬腭枕大孔线;ML,斜坡枕大孔线;CMA,延髓脊髓角;JOA,日本骨科协会

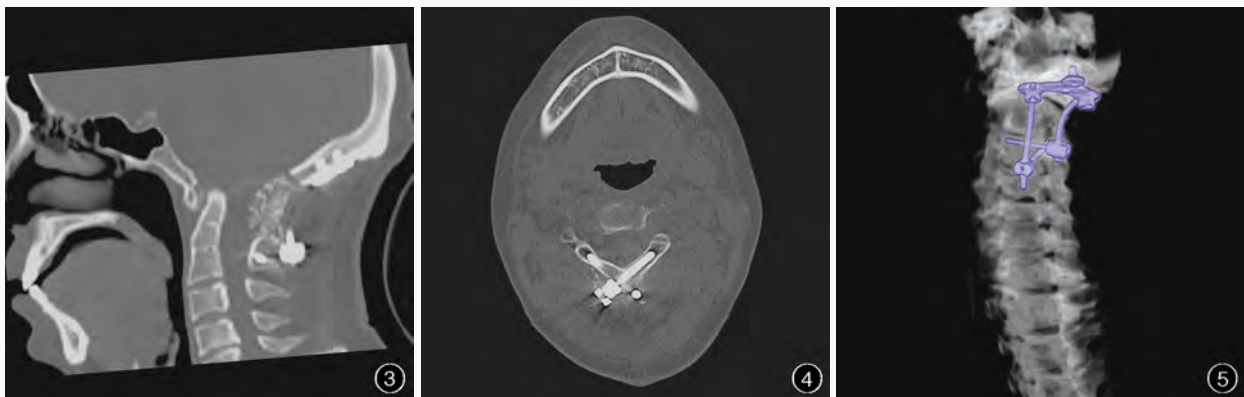


图 3 术后矢状位 CT 检查显示,齿状突完全复位,枕颈融合良好 图 4 术后横断面 CT 扫描可见螺钉在椎板内的轨迹 图 5 术后三维 CT 重建成像显示钉棒系统及枕骨钛板稳定

Figure 3 Postoperative sagittal CT: dens reduction and occipitocervical fusion Figure 4 Postoperative sectional CT: the intralaminar screws track Figure 5 Postoperative 3D CT reconstruction: stable screw-titanium rod (plate) system

颅颈交界区的解剖关系,防止病情进一步恶化。因此,手术效果取决于手术策略是否兼顾延髓减压和颅颈交界区的稳定性,上述解剖特点决定了此项手术具有较高的难度及风险,且枕颈融合在上颈髓的稳定性中起重要作用<sup>[6]</sup>。寰枢椎单纯水平脱位的严重程度可采用寰齿间距进行评价;水平脱位同时伴有垂直脱位,则以硬腭枕骨大孔线及斜坡枕骨大孔线评价脱位严重程度;延髓脊髓角则用于判断脊髓受压程度。本组有 5 例患者为单纯性寰枢椎水平脱位,其余 7 例均于水平脱位基础上伴垂直脱位,我们采用经枢椎椎板交叉内固定治疗颅颈交界区畸形合并寰枢椎脱位患者,手术操作相对简便、安全,疗效良好(表 1)。

关于寰枢椎脱位的手术方式,既往多采用经口腔齿状突磨除术<sup>[7]</sup>,解除局部骨质结构及变性韧带对脊髓的压迫,术后患者临床症状可暂时缓解。但该术式存在一些缺陷,如术前准备时间较长,术中视野显露困难,手术时间相对较长,术后影响进食,可引起感染、脑脊液漏甚至构音障碍等并发症,易影响寰枢关节的稳定性<sup>[8]</sup>,随访中可出现延髓脊髓角减小。随着影像学诊断技术的不断进步及经后路内固定器械的发展,经后路施行钉棒系统内固定技术越来越受到重视<sup>[9-10]</sup>,多数患者伴寰枕融合,采取切除枕骨大孔后缘减压,术中调整患者头位于中立位,固定头架后行双侧枢椎椎板螺钉内固定<sup>[11]</sup>,枕骨倒“Y”形钛板螺钉固定,撑开器撑开,达到齿状突向前下移位的目的。为得到永久坚固的内固定,可采用剔除枢椎棘突皮质骨的骨表面,切取自体髂骨行枕颈融合。另外,相当一部分患者还伴有小脑扁桃体下疝及脊髓空洞症,采用钉棒系统内固定无需行小脑扁桃体切除及空洞术分流术,可显著降低手术风险、减少颅内感染机会。该术式创伤小,无需牵引和气管切开即可将齿状突向前、向下推移。术后 CT 和 MRI 检查可见寰齿间距减小、延髓脊髓角增大,脑脊液循环良好,目前随访效果良好。

经后路寰枢椎侧块植骨线缆关节融合固定术(Gallie<sup>[12]</sup>)、后路寰枢椎双侧椎板线缆关节融合固定术(Brooks 和 Jenkins<sup>[13]</sup>)均为间接固定齿状突后脱位的经典手术方法,但术后仍需提供一定的外固定支持,适用于无寰枕融合者。近年来,经后路椎弓根内固定技术日趋成熟,但术中枢椎椎弓根植入钛钉时,操作范围广泛易引起颈丛神经及周围静脉丛损伤,尤其是体型肥胖者;尽管术中 CT 等辅助检

查技术的不断提高,但仍有损伤椎动脉的可能<sup>[14]</sup>。鉴于此,我们采用交叉椎板螺钉<sup>[15]</sup>并于术前对手术方案进行系统分析,制定正确的手术策略,评价内容包括椎板强度、进钉角度, MRI 所示颅颈交界区对脊髓尤其是延髓的压迫关系,同时行颅颈交界区 CTA、CT 薄层扫描及三维重建术,通过其冠状位或横断面图像可清晰地观察椎动脉经过横突孔穿出的走行和棘突全貌。此外,术中患者体位严格保持中立位,按照术前模拟执行固定姿势,再次测量螺钉位置,直视下保证正确的进钉点及角度,确定植入的钛钉位于椎板内,从而保护椎动脉<sup>[16]</sup>;术后神经电生理学检查较术前潜伏期缩短、波幅增大,且无一例发生硬脊膜、脊髓、神经根和椎动脉损伤并发症,固定满意并融合稳定;术后早期复查 CT,确认复位效果及螺钉的准确位置,以及有无螺钉拔出、内固定松动等事件发生。对本组 12 例患者手术前后数据分析表明,钛钉-钛棒(板)系统用于经后路椎板固定术治疗效果理想且安全可靠。但枕颈融合术后患者颈部活动角度会有不同程度受限。

近年来,有文献报道经后路椎板复位及螺钉-钛棒(板)内固定技术<sup>[17-18]</sup>,但仅限于个别病例,我们认为经后路椎板内固定术是治疗颅颈交界区畸形伴寰枢椎脱位的有效方法。且生物力学研究结果亦显示<sup>[19-20]</sup>:可达到与椎弓根螺钉相同的固定效果。其不仅在枕部减压方面具有优势,而且操作相对灵活、方便,上棒容易,枕骨板固定牢固,可减少颅内损伤;撑开及植骨手术便于掌握<sup>[21]</sup>,术后能迅速缓解患者痛苦,值得临床推广应用。

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(收稿日期:2012-07-12)

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